SYNOPSIS

Ph.D. in Food Science and Nutrition

Triple Burden of Malnutrition in Young Adult Women (18-21 years) and the Effect of Nutrition Interventions on their Nutritional Status and Nutritional Knowledge

By

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a). Title of the thesis

Triple Burden of Malnutrition in Young Adult Women (18-21 years) and the Effect of Nutrition Interventions on their Nutritional Status and Nutritional Knowledge.

b) Brief description on the state-of art of the research topic

Triple Burden of Malnutrition is a global health concern that has an impact on nutritional problems by raising health care costs and lowering productivity, which locks future generations in a cycle of poverty and is found around the world and is a health issue in every country. Underweight, Overweight and Micronutrient Deficiencies make up the Triple Burden of Malnutrition. According to WHO (2022) predictions, the Triple Burden of Malnutrition affects over 2 billion people worldwide. All disorders such as wasting, anaemia, stunting, and deficiencies in micronutrients are included in the malnutrition category. Micronutrient deficiency, also referred to as hidden hunger, is a type of under nutrition in which people are deficient in vital vitamins and minerals, which are critical for normal growth, disease prevention, and general well-being.The prevalence of over weight and obesity, besides there is an increase in malnutrition, wasting and stunting.Triple Burden of Malnutrition is generally caused by environmental factors, namely eating behaviour , physical activity and socio-economic conditions Since there are no outward signs of this illness, diagnosis is challenging without close observation and investigation. In the past, malnutrition was categorised as double burden of malnutrition, focusing mainly on calorie intake and included both underweight and overweight conditions. There is room to include a new dimension because the dual burden of malnutrition does not adequately account for the total amount of malnutrition that is now widespread.

c) Definition of the problem

The present study was an effort to stuy of Triple Burden of Malnutrition in young adult women (18-21 years) as there was high prevalence of Triple Burden of Malnutrition in young adult women.Most of the studies are on children.There is insufficient data on the long term health consequences and effect of nutrition interventions on Triple Burden of Malnutrition.The current study aimed to educate the selected subjects with the long term health consequences as part of Nutrition Education and to analyse the effect of dietary intervention on nutritinonal status of young adult women having any form of Triple burden of Malnutrition and to prevent the occurrence of Triple burden of Malnutrition among the target group of population.

d) Objectives and scope of research work

1. Study the socio-economic profile, dietary and life style pattern of the selected young adult women.
2. Assess the nutritional status of the selected young adult women.
3. Develop and validate nutrition education modules for nutrition education.
4. Standardize and evaluate nutrient content, shelf life and cost of the formulated dietary supplements.
5. Study the effect of nutrition interventions on nutritional status and nutritional knowledge of the selected young adult women.

Key aspects of scope include:

- Assessing the effectiveness and sustainability of nutrition interventions in terms of designing, implementing and evaluating.
- Developing evidence based policy recommendations to address Triple Burden of Malnutrition.
- Comparing malnutrition trends and interventions across different regions and countries and understanding the global drives of Triple Burden of Malnutrition and their regional implications.
- Leveraging new technologies and methodologies like in health (mobile health) and mega data analytic to improve nutrition research and interventions.

e) Methodology

The present study consisted of five phases .In the first phase, the study was conducted at Mercy College in Palakkad, Kerala, chosen for its accessibility and availability of young adult women (18-21 years), which aligned with the study's requirements. The selection was further influenced by the cooperative attitude of the college authorities, who showcased strong coordination with the researchers. Totally 570 subjects in the age group of 18-21 years from the institution were willing to participate in the study, having obtained permission from both their parents and the institution itself. This combination of factors - suitable demographics, institutional support, and participant willingness - made Mercy College an ideal location for the present research project.

In the second phase, the study assessed the nutritional status of selected subjects using a comprehensive approach. This included four key methods: anthropometric measurements to assess physical characteristics, biochemical estimation to analyse nutrient levels in biological samples, clinical examination to identify visible signs of nutritional issues, and quantitative dietary intake assessment to understand food consumption patterns. This multi-faceted approach allowed for a thorough evaluation of the subjects' nutritional health, combining physical, biological, clinical, and dietary data.

In the third phase, this study outlines a comprehensive nutrition intervention programs addressing the triple burden of malnutrition. It involved two main components: first, the development and evaluation of nutritional supplements, including their formulation, sensory evaluation, cost analysis, nutrient profiling, and microbial safety checks. Second, the formulation and implementation of an educational initiative, which encompasses developing and validating nutrition education modules, providing health education and diet counselling to subjects, creating a website for lifestyle modification awareness, and using WhatsApp groups for monitoring and evaluation. This multi-faceted approach combined direct nutritional support with extensive education and digital outreach, aimed to effectively address malnutrition issues and promote healthier lifestyles among the study participants.

In the fourth phase, the study evaluated the effectiveness of the nutrition intervention programs through two key aspects. Firstly, it assessed the effect of dietary intervention having three type of dietary supplements on the nutritional status of the selected subjects by comparing the physical and biochemical indicators before and after the dietary intervention. Secondly, it examined the effect of nutrition education which influenced the subjects' nutritional knowledge, probably using pre- and post-intervention assessments to measure changes in understanding of dietary principles. By combining these two elements, the research aimed to provide a comprehensive view of the intervention's success, addressing both the practical improvements in nutritional health and enhancement of nutrition-related knowledge, attitude and practices among the selected subjects.

In the fifth phase, the data was consolidated and analysed with appropriate tools using SPSS. Descriptive measures were analyzed using percentage, Mean and Standard Deviation and Categorical variables were compared using the Karl Pearson $\chi 2$ test .Continues variable was analyzed by Karl Pearson Correlation. Comparison of means performed using independent sample T- test. To determine the significance of the effect of nutrition intervention programmes

using pre and post intervention, Paired *t*-test was performed .One way ANOVA (analysis of variance) was used to find out the statistical significance among the three variations of the developed products used for dietary interventions.

f) Original Contributions

According to the socioeconomic profile of the selected subjects (N=570), 19percent of the selected subjects were 18 years old, 16percent were 19 years old, 38percent were 20 years old, and 38percent were 21 years old. Distribution of educational status of the selected subjects showed that 36percent of the chosen subjects were from the first year of their undergrad course, and 64percent of the subjects were from the second year of their undergrad programme. According to areas of residence of the selected subjects, 29percent of the subjects were from rural areas and 71percent of the subjects were from urban areas. It was evident to note that the selected subjects from urban areas had easy access to medical services and other conveniences. 28 percent of the subjects selected were found to be members of the joint family, and 72 percent belonged to a nuclear family, of which nine percent had two members, 11 percent had three, 52 percent had four, and 28percent had five members in their family. It was indicated that when a family grows, there is a corresponding drop in the quantity and quality of foods available to each member, which exacerbates malnutrition. Marital status was examined and it was found that 15percent of the selected subjects were married, and 85percent of the subjects were unmarried. The study examined the occupations of the mothers of the selected subjects and found that 16 percent were homemakers, 21 percent were government employees, 34 percent in the private sector, and 29 percent were self-employed. The fathers' occupations of the selected subjects showed that 53percent worked for the government, 18percent for the private sector, and 29percent for had their own business. The result regarding the monthly income of the family stated that monthly income of the family is divided in to three groups as per Kuppuswamy scale (2022), ≥184,376rupees, 92,191-184,370 rupees, 68,967-92,185rupees, 46,095-68,961rupees, 27,654-46,089rupees, 92332-27,648 rupees < 9226 rupees and percent of selected subjects in each above mentioned group are two percent, 15 percent, 17 percent, nine percent, 41 percent, 16 percent, 16 percent and one percent respectively.

The ABCD (Anthropometric, Biochemical, Clinical and Dietary) nutritional status assessment was used to conduct the screening procedure. The mean height of the subjects selected for this study, as determined by anthropometry, was 154.83±5.45 cm, which was less than the standard height of women recommended by ICMR NIN (2020). Similarly, the mean weight of the

subjects (N=570) selected for this study was found to be 57.35±11.09 kg, which was more than the standard weight of 55 kg recommended by ICMR NIN (2020). According to the data related to BMI results, 69 percent of the selected subjects were underweight, with the BMI of less than 18.5; 12 percent were in the range of 18.5-24.9, which was normal; 14 percent were in the over-weight category, with a BMI of 25-29.9; four percent were in the range of 30-34.9, which was the category of Obesity Grade I; one percent were in the range of 35-39.9, which was the category of Grade II Obesity; and none of the subjects were in the range of Grade III Obesity, which is defined as being higher than 40 BMI. WHR revealed that 14 percent of the selected subjects were in the range of 0.7-0.75, 37 percent were in the range of 0.76-0.8, 17 percent were in the range of 0.81-0.85, and 32 percent were in the range of 0.85-0.9 of WHR. Interestingly, the WHR mean was 0.768±0.027, which was within the normal range of less than 0.8 for women's WHR.

Biochemical estimation of 570 selected subjects was conducted with the help of physician and laboratory technician. Out of 570 participants, 214 subjects (or 38percent) had haemoglobin level below the normal limit of 12 dm/L whereas the normal range for blood calcium is 8.7–11 mg/dl, 16percent had levels between 8 and 8.7 mg/dl. Serum iron and folic acid were also estimated and 214 subjects with low haemoglobin. Folic acid levels ranged from 2 to 4 ng/dl in 54percent of the selected subjects, although the typical range is 4.8 to 37.3 ng/dl. Of the selected subjects, 46percent had Serum iron levels that were low (30-50 µg/dl), although the normal range for serum iron is 50–170 µg/dl.

Based on the findings of the clinical examination, four percent of the subjects had pallor as the signs and symptoms of micro nutrient deficiency. In 14percent of the selected subjects, fatigue as the indicator of iron deficiency anaemia. In 18percent of the selected subjects had bowel movements problems. Menstrual abnormalities accounted for the menstrual difficulties experienced by 22percent selected subjects. 12 percent of the subjects that were selected had visual issues. 30 percent of the subjects who were selected reported problems with hair loss. There were no cases of dyspnea, palpitations, bitot spots, or bleeding gums among the selected subjects. The most significant indicators of iron deficiency anaemia were found in those selected subjects who experienced weariness and irregular menstruation. The subjects who were selected and experienced constipation might have had bad eating habits, such as consuming insufficient amounts of dietary fibre on a daily dietaries. Sufficient consumption of dietary fibres is beneficial for promoting gut health and preventing illnesses. Diseases affecting ingestion, gastrointestinal motility, digestion, and absorption, as well as illnesses that result in

higher losses or circumstances where requirements are raised as the result of increased energy expenditure and/or protein catabolism, are examples of risk factors for the occurrence of health issues related to malnutrition.

The 24-hour recall findings showed that the mean consumption of energy carbohydrate, protein, fat, calcium, iron, folic acid, vitamin C, vitamin A, and dietary fibre was recorded for the selected subjects of 18–21 age group and were 1846.71 Kcal ±271.28, and the 157.15 g ±33.84, 53.28 g ±25.98, 17.53 g ±10.67, 613.06 mg ±283.96, 18.14 mg ±5.92, 164.49 µg ±35.23, 36.23 mg ±15.83, 480.74 µg ±210.94, and 23.07 g ±11.88 respectively. The observations revealed that the selected subjects had surplus in macro nutrients and deficient in micro nutrients .The information gathered showed that the conditions of over nutrition and deficiency brought on by micronutrient deficits were related to the excess consumption of macronutrients and the deficient consumption of micronutrients.

Anthropometric measurements, including as height, weight, hip and waist circumferences, and the calculation of BMI and WHR, were recorded for subjects and biochemical estimation on selected 570 subjects. Additionally, blood tests for serum calcium and haemoglobin concentration were carried out on 570 subjects. 16 percent of the 570 subjects were underweight and did not have any micronutrient deficiencies. 40 percent of the subjects were underweight and had micronutrient deficiencies. Of the chosen subjects, 19percent were overweight but did not have a nutritional deficiency. 14 percent of the subjects who were selected had micronutrient deficiencies, specifically insufficient folic acid. The 214 subjects who were chosen had low haemoglobin levels and were therefore further examined for serum iron and serum folic acid. The findings revealed that out of 214 subjects, low serum iron was present in 33percent of the selected subjects and low serum folic acid was present in 38percent of the subjects. Low serum calcium was present in 29percent of the selected subjects.

Three Dietary Supplements were formulated to address the Triple Burden of Malnutrition. The formulated Dietary Supplements were analysed for sensory, nutrient analysis, shelf-life study, and cost effectiveness. As the result of statistical analysis, there is a significant difference among the overall acceptance of the three variations of Sprouts Tikki was noted. The average score was 7.133 ± 1.12903 for ST1, 4.8667 ± 1.43198 for ST2, and 4.6000 ± 1.30252 for ST3. Based on these data, the most highly accepted variation was the Sprouts Tikki variation ST1. According to the data, RB1 had a mean score of 7.10±0.721, RB2 had a mean value of 6.75±1.136, and RB3 had a mean value of 6.11±0.916. The p-value for the overall acceptability

of the three variations of Ragi brownie, which is less than 0.05, was 0.011. Of the three variants, RB1 was highly accepted. For NB1, it was 6.8±1.074; for NB2, it was 6.57±0.973; and for NB3, it was 7.4±1.125. Less than 0.05, or 0.019, is the p value for the overall acceptability of the three variations of Nutri Ball. The three Nutri Ball versions differ significantly from one another as a result. The average value showed that NB 3 was the Nutri Ball variety that was most highly accepted.

One of the most important steps in the formulation of Dietary Supplements is the cost calculation. The common people must be able to access and afford the substances utilised in the development of the dietary supplement.100g of Sprouts Tikki cost Rs 30, 100of Ragi Brownie cost Rs 25 and 100g of Nutri balls cost a total Rs 20.The findings indicate that a 100g of commercially available Tikki costs Rs 65,100g of Brownie costs Rs 70 and 100g of Nutri ball/Bar costs Rs 50.

The Nutrient Analysis of Sprouts Tikki revealed that the product's moisture content was 15.33g, ash content was 7.13g, energy was 485 Kcal, carbohydrates were 31.1g, protein was 17.6 g, fat content was 5.3 g, iron was 3.4 mg, calcium was 186 mg, dietary fibre was 12 g, crude fibre was 7.5 g, and folate was 81.2 mg as sprouted green and Bengal gram were used to make Sprouts Tikki. Sprouts Tikki meets one-third RDA for fibre by ICMR NIN (2020). It was recorded that Sprouts Tikki had 0.450 mg of phytic acid per 100 g.

Upon analysis, it was found that the Ragi Brownie had an ash content of 7.22g and a moisture content of 12.16g. 406 kcal of energy, 64.2 g of carbohydrates, 18.6 g of protein, 3.8 g of fat, 5.1 mg of iron, 256.9 mg of calcium, 4.6 g of fibre, and 38.1 µg of folate were the micro and macronutrients present in Ragi Brownie. Ragi flour was a key component used in the product's development. Phytic acid is the main anti-nutrient found in the majority of millets. It was discovered that Ragi Brownie had 0.131 mg of pytic acid per 100g.

According to the results, Nutri Ball's moisture content was 12.1g and its ash content was 7.26g. The Nutri Ball's micro and macronutrient contents were as follows: 465 kcal of energy, 62.1 g of carbohydrates, 15.5 g of protein, 17.2 g of fat, 10.3 mg of iron, 186 mg of calcium, 8.4 g of fibre, and 33.1 µg of folate. A variety of components, such as horse gram and bajra, are included in Nutri Ball. It was discovered that Nutri Ball had 0.110 mg/g of phytic acid. The traditional techniques of roasting, soaking, and fermenting food can significantly reduce the amount of phytic acid present.

In a laboratory condition, the shelf life analysis of Sprouts Tikki was conducted. The pH was 6.5 on the fourth day and 7 on the seventh day. The pH range that was considered as the acceptable was 6.5-8. Less than 10 cfu/g was the total fungal count on day four, while 1x102 cfu*/g was recorded on day seven. For Total Fungal Count, the optimal range is ≤10cfu/g. On day four, the total plate count was 200 cfu/g, and on day seven, it was 15 x 102 cfu/g. The desired upper limit was 1000 cfu/g. Consequently, Sprouts Tikki had a 7-day shelf life once it was produced. After conducting a shelf life analysis, it was found that Ragi Brownie had a pH of 6.5 on day seven and 6.8 on day ten. The pH range that was most ideal is 6.5-8. On day seven, the total fungal count was less than 10 cfu/g, and on day ten, it was 1x102 cfu/g. On day seven, the total plate count was 230 CFU/g, and on day ten, it was 48 X 102 CFU/g. The shelf-life analysis indicated that Ragi Brownie can be eaten up to the tenth day. According to the shelf life analysis done on Nutri Ball, the pH of the product was 6.6 on day seven and 7 on day ten. On the seventh day, the total fungal count was less than 10 cfu/g, and on day ten, it was 2x102 cfu/g. On day seven, the total plate count was 100 cfu/g, and on day ten, it was 2x102 cfu*/g.As a result, the shelf-life analysis indicated that the product has a 10-day shelf life.

Two groups of 250 subjects each were formed from the subjects: an experimental group and a control group. It was noted that after receiving nutritional education, selected subjects in Experimental group showed an improvement in their level of understanding. In the experimental group, the percentage of selected subjects with inadequate nutritional knowledge decreased from 95percent to 58percent after the intervention. The positive attributes to be developed and negative traits to be avoided were covered in the questions on the selected subjects' attitudes towards consumption. The results shows that selected subjects in Experimental group showed a shift in attitude. Following the delivery of nutritional education to both the control group and the experimental group, it was discovered that a large number of the selected subjects avoided negative attitudes regarding consumption and enhanced positive attitudes in Experimental group. There was no major shift in Practice in Experimental and Control group subjects. Paired sample t-test was conducted to assess the effect of nutritional education on Knowledge, attitude and Practice of selected subjects in Experimental and Control group. The experimental group's knowledge level had a p value of 0.004, while the control group's was 0.223. The experimental group's p value for attitude level was 0.024, while the control group's was 0.198. The p-value for the experimental group's practice level was 0.136, whereas the control group's p-value was 0.223.

In dietary intervention program, the data gathered were expressed in terms of nutritional status. There was a difference in mean value of BMI of selected subjects in Experimental group who were supplemented with Ragi Brownie which was from 18.062±0.140to 25.068±0.140.The change in mean value of BMI in the selected subjects Control group was from 18.454±1.33to 18.37±1.33. The paired sample t-test which was conducted to assess the impact of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.046and t value was 1.421. The p value for the control group was p =0.22and t=2.322. The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test between the post values of BMI of Experimental and Control group was 0.000 and 6.879respectively.

The results on effect of Nutrition intervention on BMI of the selected subjects who were supplemented with Nutri Ball showed that the paired sample t-test which was conducted to assess the effect of nutrition intervention on BMI and the results shows that in the selected subjects in Experimental group had a p value 0.047and t value was 1.336. The p value for the control group was p =0.209 and t=2.338.The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test was 0.000and 6.996 respectively. The results for Ragi Brownie showed that the paired sample t-test which was conducted to assess the impact of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.046and t value was 1.421. The p value for the control group was p =0.22and t=2.322. The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test was 0.000 and 6.879respectively.The results for Sprouts Tikki showed that the paired sample t-test which was conducted to assess the effect of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.021 and t value was 2.092. The p value for the control group was p =0.110and t=3.788.The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test was 0.00 and 6.873 respectively.

The results for WHR showed that there was an effect on selected subjects in Experimental Group before and after the Nutrition Intervention who were supplemented with Nutri Ball, Ragi

Brownie and Sprouts Tikki . The results for WHR in Experimental Group and Control group before and after the Nutrition Intervention where the effect of nutrition education was not evident. The change in WHR in both Experimental and Control group was not a prominent value as the p value is more than 0.05 .Therefore the effect of nutrition intervention was not beneficial in bringing out an effect on WHR of Experimental and Control group.It may be due to the short duration of dietary intervention.

In case of improving the Iron status in blood ,nutrition intervention had a great impact as the presence of Iron in blood raised from 41.876±4.976 to 88.486±32.463 in Experimental group who were supplemented with Nutri Ball.There was no improvement in Control group with respect to Iron status as the change was from 33.928±7.990 to 33.93600±7.993 . The paired sample t-test which was conducted to assess the impact of nutrition intervention on Serum Iron and the results showed that in the selected subjects in Experimental group had a p value 0.026and t value was 9.998. The p value for the control group was p =0.376 and t=2.296.The p value is less than 0.05, therefore there is a significant difference in Serum iron level in Experimental group. The p value and t value for independent sample t test was 0.000 and 11.459 respectively.

The mean value of Serum calcium in Experimental group who were supplemented with Ragi Brownie moved from 6.794±1.013 to 8.2796±1.010 and in Control group it was moved from 6.995±0.556 to 7.231±0.7185.There was a change in Serum Calcium in both Experimental and Control group but it was prominent in Experimental Group. The paired sample t-test which was conducted to assess the impact of nutrition intervention on Serum Calcium and the results shows that in the selected subjects in Experimental group had a p value 0.009 and t value was 8.82. The p value for the control group was p =0.126and t=2.296.The p value was less than 0.05, therefore there was a significant difference in Serum Calcium level in Experimental group. The p value and t value for independent sample t test was 0.000 and 6.989 respectively.

The mean value of Serum Folic Acid had raised to 4.635±1.981 from 3.135±0.522 in Experimental Group who were supplemented with Sprout Tikki and in Control group it had raised to 2.907±0.6702 from 2.696±0.694. The paired sample t-test which was conducted to assess the effect of nutrition intervention on Serum Folic Acid and the results showed that in the selected subjects in Experimental group had a p value 0.001and t value was 5.575. The p value for the control group was p =0.133 and t=3.267.The p value was less than 0.05, therefore

there was a significant difference in Serum Folic Acid level in Experimental group. The p value and t value for independent sample t test was 0.000 and 6.996 respectively.

The results of effect of Nutrition Intervention on Signs and Symptoms showed that in the selected subjects in Experimental group who were supplemented with Nutri Ball , there was slight improvement in the selected subjects with Pallor(Conjunctiva, Palms, Nail Beds, Tongue) where signs had come down to 2.3 per cent subjects from has come down 2.4 per cent in Experimental group. There was slight improvement in signs and symptoms for fatigue where it had moved to 6.7 per cent subjects from 7.2 percent subjects in Experimental group. There was also an improvement in menstrual irregularities from 7.2 percent subjects to 6.4 per cent subjects in Experimental group.

The results with Ragi Brownie stated that there was slight improvement in signs and symptoms of Fatigue, Bowel Movement and Menstrual Irregularities in Experimental group.The improvement in Fatigue was from 2.0 percent subjects to 1.8 per cent subjects, in Bowel Movement was from 3.2 per cent subjects to 3.0 per cent subjects and Menstrual Irregularities was from 4 per cent subjects to 3.7 per cent subjects.

The results for Clinical signs and symptoms show that the mean value with in the Experiment Group was 1.004±0.021 and Control Group was 0.10±0.011 and mean difference between groups was 0.167 .There was no evident change with the Clinical signs and symptoms as the p value for this parameter was 0.211 for Experimental group and 0.349 for Control group. The p value in both Experimental and Control group was more than 0.05.Therefore there was no significance difference .The results depicts that there was no significant impact on clinical signs and symptoms of both Experimental and Control group. The p value and t value for independent sample t test was 0.077 and 0.988 respectively.

The results of 24 hour recall for the effect of nutrition intervention showed that there was a shift in the amount of nutrients consumed by the Experimental and Control Groups before and after the Nutrition Intervention. The Experimental group experienced the following changes: Energy headed from 1871.05±180Kcal to 1893.05±186 ; Carbohydrates changed from 154.14±33.4 to 149.02±42.9; Fat from 18.71±11.2 to 11.02±13.6; Calcium from 614.6±268.4 to 633.1±204.4; Iron from 17.2048±5.22 to 21.144±3.14; Folic Acid from 163.99±34.3 to 168.31±30.3; Vitamin C from 35.3±15.6 to 36.1±11.3; Vitamin A from 469.5±209.1 to 469.754±209.1; and Dietary Fibre from 22.9±10.9 to 31.8±1.1.The was an increase in Energy by 21.95 Kcal ,Calcium by 18.5mg , Folic Acid by 4.32µg and Dietary Fibre by 8.9 g.There

was a meagre increase in Vitamin C ,A and Protein.The was a fall in the consumption of Carbohydrates and Fat by 5.12g and 7.69g respectively .The change in the consumption pattern in the selected subjects can be due to the Nutrition Intervention. The selected subjects were provided with comprehensive knowledge in nutrition and health benefits of following a proper diet and exercise. The change in the result related to nutrient consumption indicates that there was an impact on the selected subjects with respect to nutrition education.

In control group the change in nutrient consumption was from 1888.076±193 to 1891.024±193 in Energy and 165.01±54.8 to 165.01±44.9 in Carbohydrates.There was an increase in protein from 36.57±26.02 to 40.33±26.9.There was only a meagre change in the consumption of fat which was from 10.12±17.4 to 10.01±19.2.There was a decrease in Calcium consumption from 701.5±233.1 to 655.1±204.4 and in Iron consumption from 23.678±9.16 to 23.132±0.14.There was a small change in Folic Acid consumption from 154.22±98.5 to 155.35±33.3.There was decrease in Vitamin C and Dietary Fibre which was from 39.1±0.4 to 36.77±1.1 and 18.98±0.1 to 18.3±1.6 respectively. The change in Vitamin A was from 308.709±222.1 to 311.098±166.7.The change intake of nutrients could be because of the lack of knowledge they have regarding the importance of proper nutrients in life as the selected subjects in control group was not a part of nutrition education programme. Therefore young adult women need to pay attention to a healthy lifestyle in terms of nutritious diet, proper adaptation of physical activity with proper nutritional knowledge to avoid nutrition and health problems both over and under nutrition problems.

g) Paper published

- Sai Gayathri, H., & A.Thirumani Devi. (2023). Triple burden of malnutrition: A Reminder to Reform. *Indian Journal of Nutrition and Dietetics*,60(1)
- Sai Gayathri, H., & A.Thirumani Devi. (2023). Ragi Brownie-A Millet based approach towards Triple Burden of Malnutrition. *The Indian Journal of Home Science, 35*(2).

h) Conclusion

- Nutrition interventions had an impact on the nutritional status and nutritional knowledge of young adult women.
- Nutritional education imparted to the young adult women benefits to grasp the importance of consuming nutritious foods. The results of the KAP study showed an improvement which will fulfil the health and nutritional requirements.

- A major shift in interpretation of consumption of various food groups is brought in through diet counselling and supplementation which is a key factor to consume quality foods with nutritional adequacy thus paving way for a healthier workforce.
- A diet based approach is one of the sustainable way to prevent the occurrence of Triple Burden of Malnutrition and also promote health status of an individual.

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